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Description

FEEDTHROUGH AND COMMON GROUND FOR ELECTRICAL CABLES

BACKGROUND OF INVENTION

[0001] Field of the Invention

[0002] The invention relates to apparatus for electrical cable coupling. More particularly, the invention relates to a cost effective coupler for multiple electrical cables that may incorporate bulkhead penetration, useful as a component of a lightning protection system.

[0003] Description of Related Art

[0004] Electrical cables, for example coaxial transmission lines of antenna towers, are grounded to provide an electrical path to ground for dissipation of electrical current resulting from, for example, static discharge and or lightning strikes. Industry standards such as IEC 1024-1 and MIL-STD-188-124A have been developed to ensure that the grounding electrical circuit can handle expected current

and voltage levels. According to these standards, each part of the grounding electrical circuit is provided with, for example, galvanically compatible interconnections having a minimal cross connection resistance of less than 1 milliohm and a conductor cross sectional area of at least 16 millimeters-squared (where the conductor is copper material).

[0005] Prior electrical grounding solutions have included clips, straps or the like for connection to the outer conductor of the cable and or connector unions placed in-line along the electrical cable. Individual interconnections with each cable and then to a grounding bus create a significant cost which increases with each additional cable that requires grounding. Further, each individual interconnection must be tightened to a specified torque level or the electrical resistance across the interconnection may unacceptably vary.

[0006] To form a secure electrical connection with the outer conductor, any outer protective covering of the cable is removed, creating an entry path for moisture that may, over time, degrade the exposed conductor and or the quality of the electrical connection(s). Prior electrical grounding solutions have typically included a sealing component such

as gaskets, waterproofing wraps and the like. Proper application of these sealing solutions may require trained and motivated installation personnel.

[0007] As electrical cables enter a structure, they are typically routed through dedicated apertures of a bulkhead penetration panel that supports and seals each cable. Prior grounding solutions incorporated into bulkhead penetration panels have required a large number of individual components for sealing the cable entry, electrically coupling with the outer conductor of each cable and then to a common ground bus. The large number of discrete components and interconnections involved resulting in prior solutions with significant manufacturing costs, installation labor requirements and administrative overhead.

[0008] Competition within the electrical cable and associated accessory industries has focused attention on cost reductions resulting from increased manufacturing efficiencies, reduced installation requirements and simplification/overall number of discrete parts reduction.

[0009] Therefore, it is an object of the invention to provide an apparatus that overcomes deficiencies in the prior art.

Brief Description of Drawings

[0010] The accompanying drawings, which are incorporated in

and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[0011] Figure 1 is an isometric schematic view of the inside facing surface of a first embodiment of the invention, in an open position.

[0012] Figure 2 is an isometric schematic view of the inside facing surface of a first embodiment of the invention, in a closed position.

[0013] Figure 3 is an isometric schematic view of the outside facing surface of a first embodiment of the invention, in a closed position.

[0014] Figure 4 is an isometric schematic close-up view of the grounding strap cable contact surfaces of the first embodiment.

[0015] Figure 5 is an isometric schematic close-up view of the sealing gasket cable contact surfaces of the first embodiment.

[0016] Figures 6 is an isometric exploded schematic view of a second embodiment of the invention.

[0017] Figure 7 is an isometric schematic view of the second em-

bodiment of the invention, assembled.

[0018] Figure 8 is a close up view of Figure 6.

Detailed Description

[0019] The invention is described in an exemplary first embodiment with reference to the various views of the first embodiment shown in Figures 1-5. The invention is described herein with respect to an electrical cable having an outer conductor. The electrical cable may be any type of, for example, coaxial cable, waveguide, multiple conductor cable or the like. Further, different types of electrical cable may be coupled together by the invention.

[0020] A feedthrough and common ground for electrical cables (FCGEC) 1 according to the first embodiment of the invention has a base plate 3 with an inward projecting flange 5 against which a support insulator 7 is seated. The support insulator 7 supports, electrically isolated from the base plate 3, a ground strap 9. A retaining insulator 11 and a fastening plate 13 are adapted to mate with the ground strap 9 to secure electrical cables (not shown) installed within a plurality of cable receiving portion(s) 15 formed in the ground strap 9. A plurality of corresponding compression hole(s) 16 may be formed in the fastening plate

13, retaining insulator 11, ground strap 9, support insulator 7 and the flange 5 for compression bolts, screws or the like (not shown) which, upon installation, operate to join and compress the components together creating a secure, low resistance electrical connection between the outer conductor of each electrical cable and the ground strap 9.

[0021] As best shown in Figures 4 and 5, respectively, each cable receiving portion 15 of the ground strap 9 and a corresponding retaining insulator 11 cable retaining portion 17 has an inner diameter adapted to receive the outer conductor of the desired electrical cable. Similarly, the invention may be adapted for use with cables with other than circular cross sections, for example, an oval transmission line by adapting the cable receiving portion 15 and cable retaining portion 17 to mate with the corresponding oval outer cross section of the transmission line.

[0022] Lip edge(s) 19 protruding radially inward to a smaller diameter than the cable receiving portion 15 may be formed at the top edge of the cable receiving portion(s) 15 to create a press into place retaining function for an electrical cable pressed past the lip edge(s) 19 into each cable receiving portion 15.

[0023] The ground strap 9 is formed from a metal or metal alloy, for example copper, which is galvanically compatible with the outer conductor of the desired electrical cable. A ground bus connection point 20 for coupling the ground strap 9 to earth ground may be formed, for example, at one end of the ground strap 9. Preferably formed from a single piece of the selected material, the ground strap 9 may be dimensioned to have at least a minimum cross sectional area according to the applicable electrical standard. Further, the ground strap 9 may be dimensioned to have a length, along the longitudinal axis of the electrical cable that provides suitable contact area with the electrical cable. Where the outer conductor of the electrical cable is corrugated, reducing the contact area, the length may be extended accordingly.

[0024] An aperture 21 formed in the base plate 3 may be dimensioned to allow passage of electrical cables with connectors or other components already installed. Inserted through the aperture 21, each cable may be pressed into a cable receiving portion 15 where it is temporarily secured by the lip edge(s) 19. Unused cable receiving portion(s) 15 may be plugged with, for example, a length of scrap cable or other appropriately dimensioned plug. The fastening

plate 13 is dimensioned to close the aperture 21 when in place upon the ground strap 9. The retaining insulator 11, supported by the fastening plate 13, may be shaped to also seal the closure of the fastening plate 13 upon the aperture 21. A series of retaining hole(s) 22 around the aperture 21 and fastening plate 13 periphery may be used to finally fix the fastening plate 13 into place upon the base plate 3 via removable fasteners such as screws (not shown).

[0025] The ground strap 9 may be electrically isolated from the base plate 3 and fastening plate 13 by forming a shoulder 23 in the support insulator 7 or retaining insulator 11. Similarly the compression bolt bolts may be isolated from the ground strap 9 by a plurality of protruding portion(s) 25 and corresponding depression(s) 27 in the support insulator 7 and retaining insulator 11 or vice versa. Preferably, the insulator material, in addition to non-conductivity, has resilient sealing properties. Suitable materials for the support insulator 7 and retaining insulator 11 include, for example, butyl rubber, nitril, epdm and silicon. The shoulder 23 also operates to seal the ground strap 9 from the outside environment and allows the support insulator 7 to seat against the retaining insulator 11

sealing around the outer conductor of each electrical cable to inhibit moisture infiltration.

[0026] The first embodiment is demonstrated as a 12 electrical cable configuration. In alternative embodiments, the number of electrical cables the FCGEC 1 is adapted to receive may be varied. For common interconnection of electrical cable outer conductors where a feedthrough is not required, for example along an exterior cable run or near the top of an antenna tower, a second embodiment as shown in Figures 6-8 may be applied. Here, like components similarly notated, the ground strap 9 may be isolated except for the protruding connection point 20 by enclosure between an oversized support insulator 7 and retaining insulator 11. Also, support insulator 7 to retaining insulator 11 direct contact is applied on both sides of the ground strap 9, along the longitudinal axis of the electrical cable. To further improve the sealing effect of the respective insulators upon and around each outer conductor of the electrical cables, sealing fin(s) 29 may be applied to cable outer conductor contacting surfaces of each insulator adapted to mate with corrugations in the outer conductor of the cable.

[0027] The present invention provides a cost effective common

coupling solution with a reduced number of components. Installation is simplified by the wide common aperture 21 available for inserting each cable and the ability of the ground strap to retain each cable prior to final installation of the fastening plate 13. Because the ground strap is formed from a single piece of material, costs may be reduced and the opportunity for faulty installation minimized. In embodiments without bulkhead penetration features, the invention similarly reduces costs and installation requirements.

[0028] Table of Parts

1	FCGEC
3	base plate
5	flange
7	support insulator
9	ground strap
11	retaining insulator
13	fastening plate
15	cable receiving portion
16	compression hole
17	cable retaining portion
19	lip edge
20	connection point
21	aperture

22	retaining hole
23	shoulder
25	protruding portion
27	depression
29	sealing fin

[0029] Where in the foregoing description reference has been made to ratios, integers, components or modules having known equivalents then such equivalents are herein incorporated as if individually set forth.

[0030] While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus, methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departure from the spirit or scope of applicant's general inventive concept. Further, it is to be appreciated that improvements and/or modifications may be made thereto without departing

from the scope or spirit of the present invention as defined by the following claims.